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SUBJECT: AAP Telemetry Data Processing Estimates - Case 620

DATE: February 7, 1969

FROM: R. J. Pauly

## ABSTRACT

The impact of Apollo Applications Program missions AAP/1 - AAP/4 on the MSC and MSFC complabs is assessed. Anticipated PCM telemetry data processing activities, complab processing capabilities and AAP data volumes are examined. Quantitative estimates are developed which indicate that the AAP/1 - AAP/4 data processing will not cause a major impact on the complabs.

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MEMORANDUM FOR FILE

## INTRODUCTION

During Apollo Applications Program (AAP) missions PCM data will be telemetered to Manned Space Flight Network (MSFN) ground sites and recorded on analog tapes. The tapes will be shipped to the MSC or MSFC complabs* for processing. This paper presents preliminary estimates of the processing loads on the complabs for the AAP/1-2, AAP/3A, and AAP/3-4 missions.

## COMPLAB PROCESSING

The data processing at the complabs will consist of:

1. Signal Processing. In this activity the data on analog tapes will be signal conditioned, converted to digital form, quality checked and recorded on master digital tapes.

2. Computer Processing. In this activity the data on master digital tapes will be quality checked, calibrated, limit checked, and sorted onto separate digital tapes or printer listings for presentation to the appropriate personnel. Additional special computations will be performed on portions of the data as required.

## PROCESSING CAPABILITIES

The signal processing will be performed on CDC 3200 computer telemetry systems at MSC and Saturn Telemetry systems at MSFC. These systems can process the recorded data from any Saturn/Apollo telemetry link at the same rate that the data were transmitted.**

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*The complabs are general-purpose computational facilities.

**This estimate is based on MSC and MSFC experience in handling Saturn/Apollo data. See References 2, 3 and 4.

Including an allowance for equipment setup time, the systems can process data at an average rate of 0.9 hours of telemetry data per hour of system operation.

The computer processing will be performed on Univac 1108 computers at MSC and MSFC. The computers can process Apollo telemetry data at an average rate of $5.54 \times 10^7$ bits per hour.*

## AAP DATA VOLUME

The volume of telemetry data acquired depends on the data transmission capabilities of the spacecraft and on MSFN ground site coverage--that portion of the mission in which the spacecraft is in contact with at least one site. Estimates of the volume of PCM telemetry data which could be acquired during the AAP/1 - AAP/4 missions are presented in Tables 1-2 and summarized below:

| | Mission Duration | Data Acquired Per Mission Day | |
|---|---|---|---|
| | | Bits | Link Hours |
| AAP/1-2 | Up to 28 days | $2.9 \times 10^9$ | 14.7 |
| AAP/3A | Up to 56 days | $2.9 \times 10^9$ | 14.7 |
| AAP/3-4 | Up to 56 days | $4.9 \times 10^9$ | 22.4 |

## ASSUMPTIONS

The following assumptions were made in developing the data processing estimates:

1. The AAP telemetry data will be processed in the same way that the Apollo telemetry data has been processed.

2. Only 25% of the data acquired will be processed. This is consistent with Gemini and Apollo experience.

3. The MSC complab will process Command Service Module (CSM) plus Airlock Module (AM) data from AAP/1-2, AAP/3A, and AAP/3-4. This is based on MSC experiment and subsystem responsibilities.

4. The MSFC complab will process AM data from AAP/1-2 and AAP/3A and AM plus Lunar Module/Apollo Telescope Mount (LM/ATM) data from AAP/3-4. This is based on MSFC experiment and subsystem responsibilities.

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*This estimate is based on MSC experience in handling Apollo data. See References 2, 3, and 4.

## DATA PROCESSING ESTIMATES

The processing loads on the MSC and MSFC complabs are estimated below. The signal processing hours and computer processing hours were calculated by dividing the data volumes to be processed by the hourly processing rates.

| Complab/ Mission | Total Mission Data Volume Bits | Total Mission Data Volume Link Hours | Signal Processing Hours Required | Computer Processing Hours Required |
|---|---|---|---|---|
| MSC AAP/1-2 | $20.2 \times 10^9$ | 103 | 115 | 365 |
| MSC AAP/3A | $40.4 \times 10^9$ | 206 | 230 | 730 |
| MSC AAP/3-4 | $40.4 \times 10^9$ | 206 | 230 | 730 |
| MSFC AAP/1-2 | $10.9 \times 10^9$ | 53 | 59 | 197 |
| MSFC AAP/3A | $21.8 \times 10^9$ | 106 | 118 | 394 |
| MSFC AAP/3-4 | $49.8 \times 10^9$ | 213 | 237 | 900 |

An indication of the AAP impact on the complabs can be obtained by comparing the complabs' resources with the estimated processing loads. The MSC and MSFC resources are as follows:

| | Signal Processing Systems | Signal Processing Monthly Hours* | Computer Processing Systems | Computer Processing Monthly Hours* |
|---|---|---|---|---|
| MSC | 2 | 1,000 | 6 | 3,000 |
| MSFC | 2 | 1,000 | 3 | 1,500 |

If one month was devoted to processing the data acquired during the 28 days of the AAP/1-2 missions it would require:

1. 12% of the MSC monthly signal processing resources.
2. 12% of the MSC monthly computer processing resources.
3. 6% of the MSFC monthly signal processing resources.
4. 13% of the MSFC monthly computer processing resources.

*The monthly hours are based on operating the systems 500 hours per month.

If two months were devoted to processing the data acquired during the 56 days of the AAP/3A mission it would require:

1. 12% of the MSC monthly signal processing resources.
2. 12% of the MSC monthly computer processing resources.
3. 6% of the MSFC monthly signal processing resources.
4. 13% of the MSFC monthly computer processing resources.

If two months were devoted to processing the data acquired during the 56 days of the AAP/3-4 missions it would require:

1. 12% of the MSC monthly signal processing resources.
2. 12% of the MSC monthly computer processing resources.
3. 12% of the MSFC month signal processing resources.
4. 30% of the MSFC monthly computer processing resources.

## CONCLUDING REMARKS

The processing estimates indicate that the AAP would not cause a major impact on the MSC and MSFC complabs. The most significant impact would be caused by the AAP/3-4 computer processing at MSFC.

These estimates are preliminary in nature. They are intended to indicate the general impact of the AAP on the complabs. As specific processing requirements are established on a mission-by-mission basis, it will be possible to prepare more definitive estimates.

There are several factors which could cause a significant increase or decrease in the estimates:

The loads will increase if:

1. More extensive reduction and analysis of the data are performed.
2. More than 25% of the data acquired are processed.

The loads will decrease if:

1. The missions do not continue for 28 days or 56 days.
2. Less than 25% of the data acquired are processed.

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Attachments
References
Tables 1-2

TABLE 1

AAP/1-AAP/2 and AAP/3A

MSFN PCM Telemetry Data Acquisition Capability

| Real Time | Transmit | Acquisition - 28% Station Coverage* (Bits per Day) | (Hours per Day) |
|---|---|---|---|
| CSM | 51.2 KBPS | $1.24 \times 10^9$ | 6.7 |
| AM | 51.2 KBPS | $1.24 \times 10^9$ | 6.7 |
| | | $2.48 \times 10^9$ | 13.4 |

| Playback** | Record | Transmit | Acquisition - 28% Station Coverage* (Bits per Day) | (Hours per Day) |
|---|---|---|---|---|
| CSM | 1.6 KBPS | 51.2 KBPS | $0.10 \times 10^9$ | 0.5 |
| AM | 5.12 KBPS | 112.64 KBPS | $0.32 \times 10^9$ | 0.8 |
| | | | $0.42 \times 10^9$ | 1.3 |
| | | Combined Total $\sim$ | $2.9 \times 10^9$ | 14.7 |

*The 28% station coverage is based on Reference 1 for a 28.3° inclination, 260 nautical mile orbit and stations with both VHF and USB support capability.

**The data acquired are based on record rate, transmit rate and station coverage. The 1.6 KBPS record rate is assumed for the CSM rather than the 51.2 KBPS record rate, since this appears to be the most likely mode of operation. It is assumed that data would be recorded during 72% of the orbit.

TABLE 2

AAP/3-AAP/4

MSFN PCM Telemetry Data Acquisition Capability

| Real Time | Transmit | Acquisition - 28% Station Coverage* (Bits per Day) | (Hours per Day) |
|---|---|---|---|
| CSM | 51.2 KBPS | $1.24 \times 10^9$ | 6.7 |
| AM | 51.2 KBPS | $1.24 \times 10^9$ | 6.7 |
| LM/ATM** | 72.0 KBPS | $1.74 \times 10^9$ | 6.7 |
| | | $4.22 \times 10^9$ | 20.1 |

| Playback*** | Record | Transmit | Acquisition - 28% Station Coverage* (Bits per Day) | (Hours per Day) |
|---|---|---|---|---|
| CSM | 1.6 KBPS | 51.2 KBPS | $0.10 \times 10^9$ | 0.5 |
| AM | 5.12 KBPS | 112.64 KBPS | $0.32 \times 10^9$ | 0.8 |
| ATM | 4.0 KBPS | 72.0 KBPS | $0.26 \times 10^9$ | 1.0 |
| | | | $0.68 \times 10^9$ | 2.3 |
| | | Combined Total ∿ | $4.9 \times 10^9$ | 22.4 |

*The 28% station coverage is based on Reference 1 for a 28.3° inclination, 260 nautical mile orbit and stations with both VHF and USB support capability.

**The LM USB system transmits in lieu of the ATM VHF system for a brief period of time prior to the LM/ATM docking with the cluster.

***The data acquired are based on record rate, transmit rate and station coverage. The 1.6 KBPS record rate is assumed for the CSM rather than the 51.2 record rate since this appears to be the most likely mode of operation. It is assumed that data would be recorded during 72% of the orbit.

## REFERENCES

1. "Coverage Analysis of Mission AAP-1 Through AAP-4 Using Orbit Inclination as a Variable," A. G. Weygand, Bellcomm Memorandum for File, May 9, 1967.

2. "Trip Report: ADP Data Processing Estimates Meeting and Mitre Status Review on MCC-H Study," R. J. Pauly, Bellcomm Memorandum for File, January 11, 1968.

3. "Trip Report: AAP1-4 Data Handling Estimates Review at MSFC," R. J. Pauly, Bellcomm Memorandum for File, April 30, 1968.

4. Conversations between the author and Mr. D. Iloff, MSC Computation and Analysis Division and Mr. J. T. Felder, MSFC Computation Laboratory, February-May 1968.